

# Application Lands

510-18



Piceance Gas Resources



Current Activity



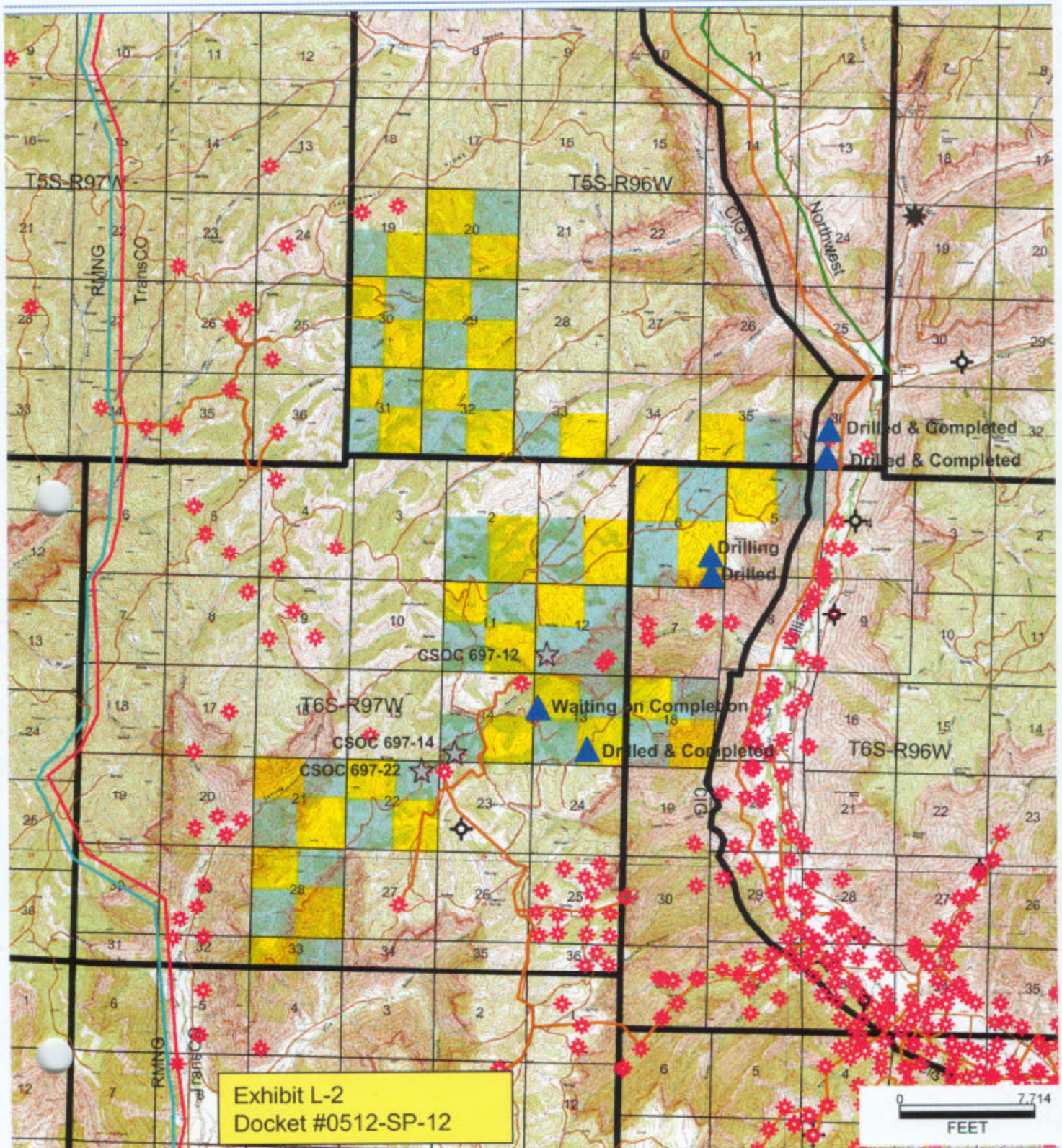
Petroleum Development Corporation



Jelco G V Inc.



01623579





# COGCC Approved 10 acre spacing (July 2005)



COGCC Approved 10 Acre Density



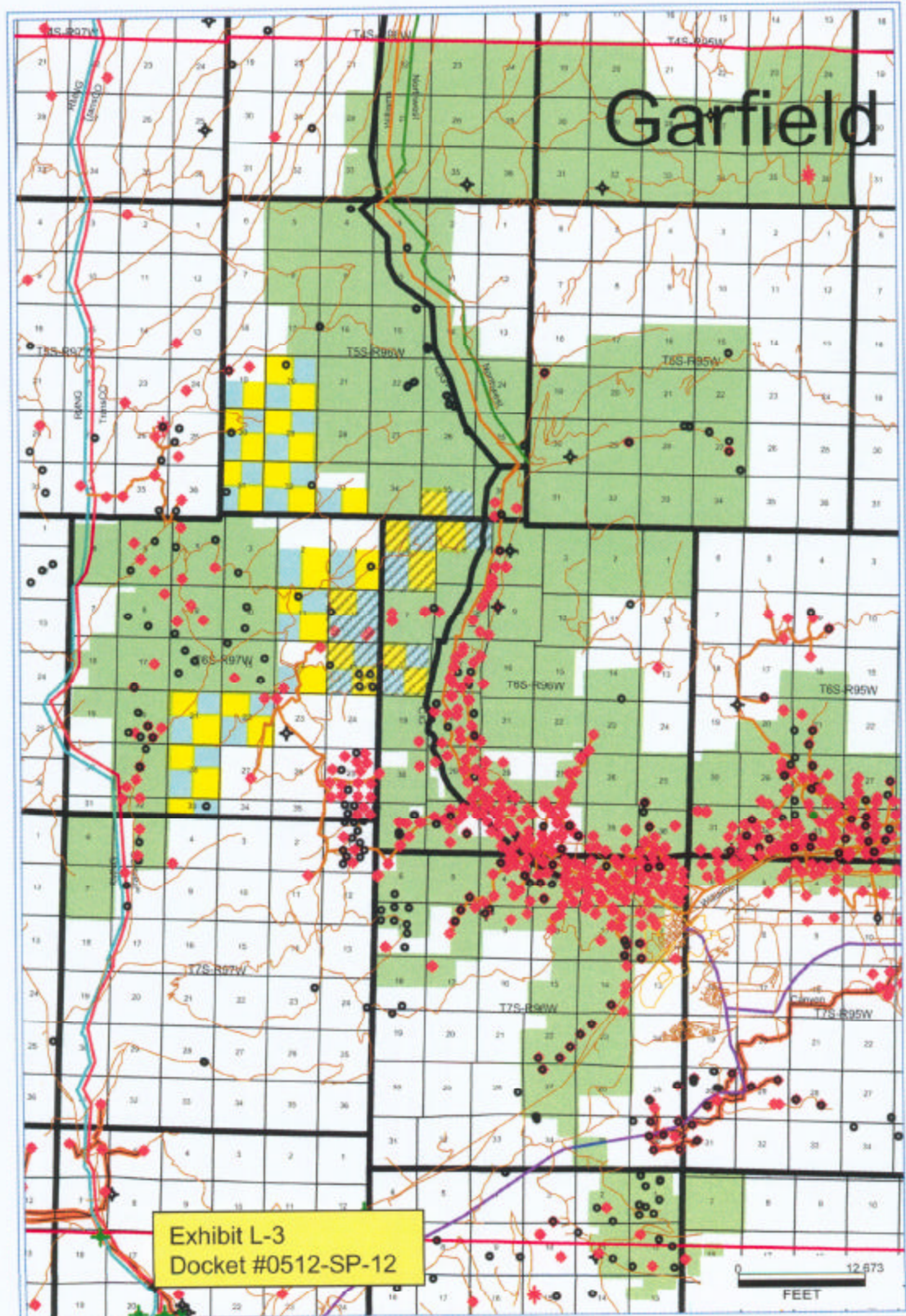
Piceance Gas Resources



Previously Approved 10 Acre Density

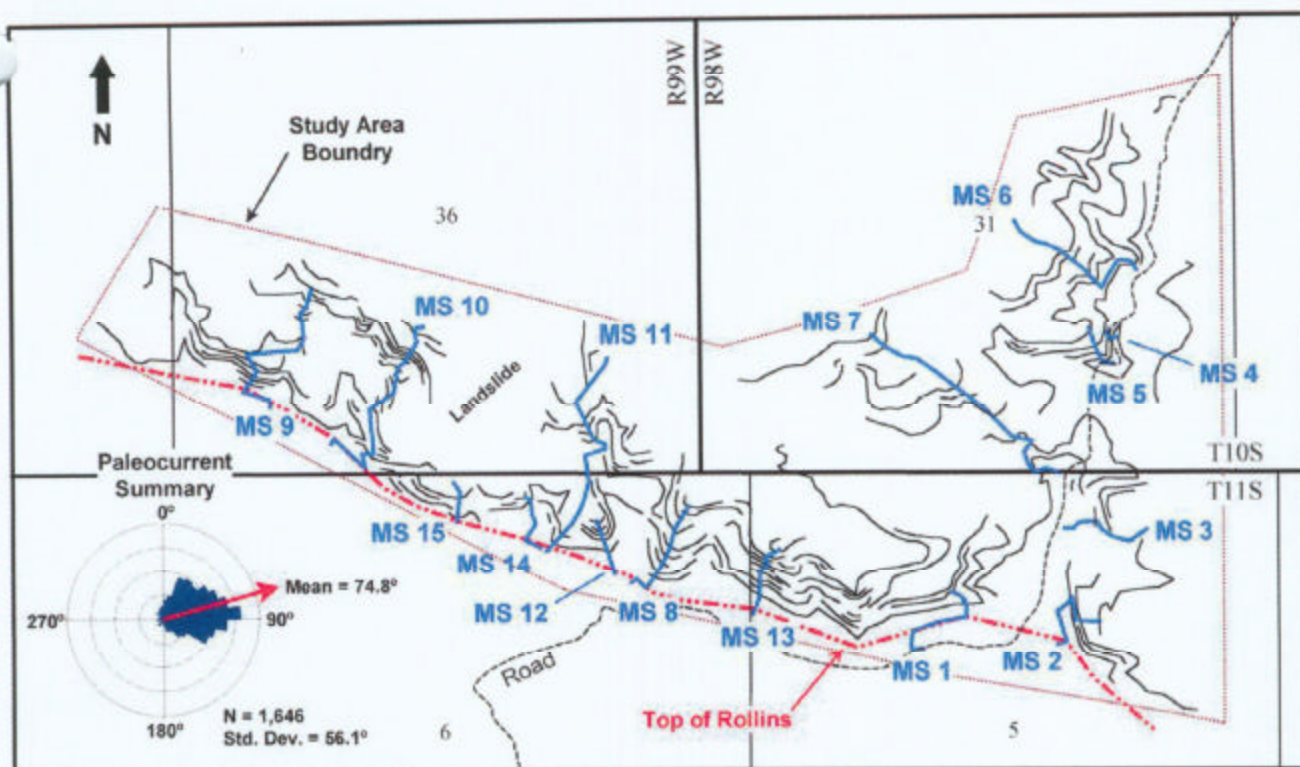


Petroleum Development Corporation



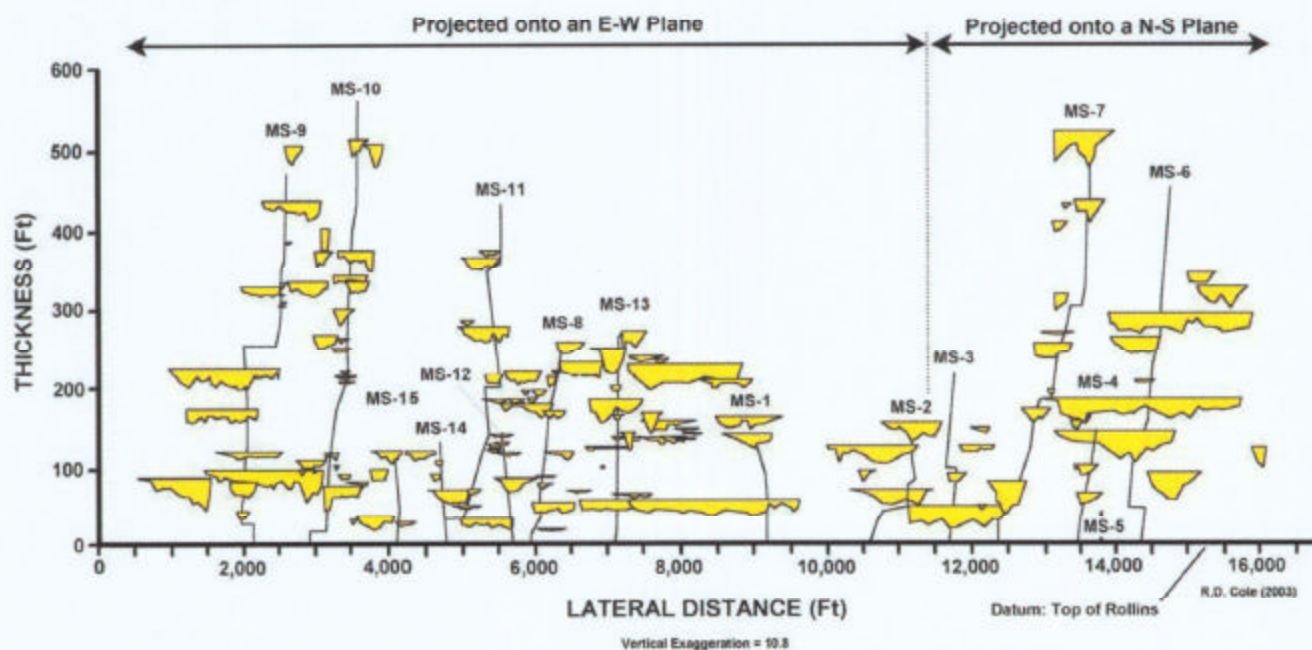


# Sand Body Illustration: Coal Canyon Mesaverde Outcrop



Sand Body Mapped by GPS

MS = Measured Section

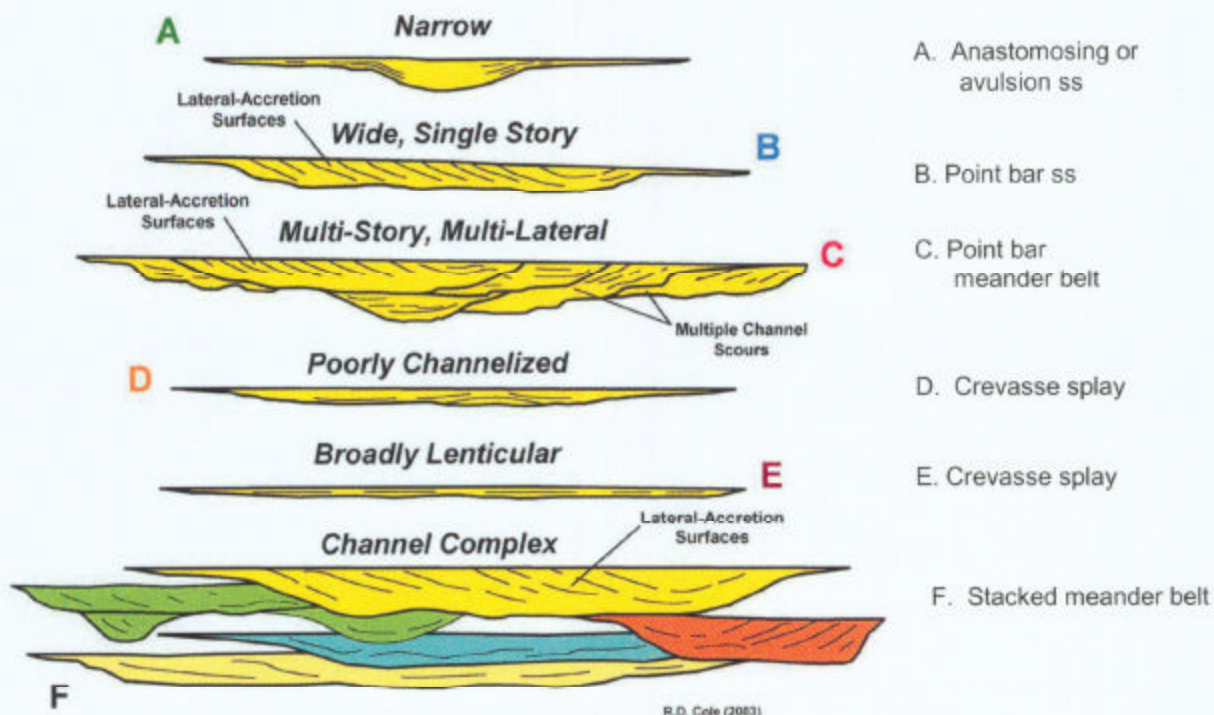
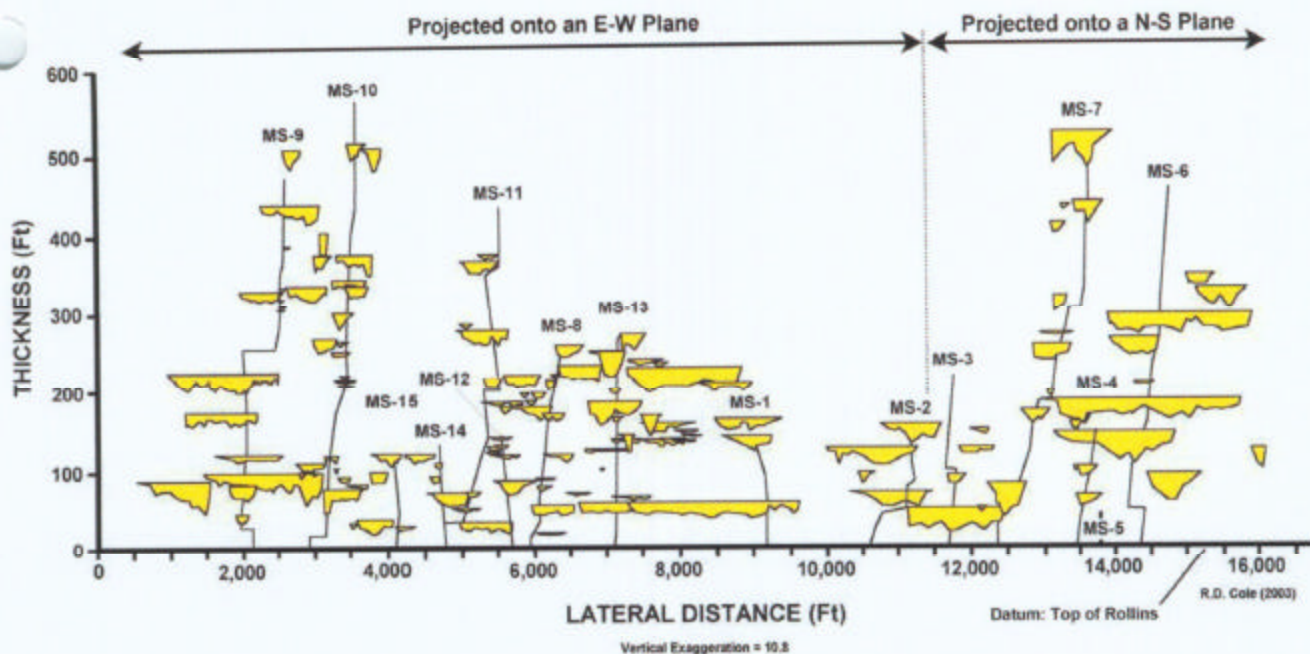


Upper illustration shows location of Coal Canyon Williams Fork outcrop and mapped individual sand bodies. Lower illustration is a diagram showing lateral and vertical relationships of sand bodies exposed in the Coal Canyon outcrop.

From Cumella and Otsby, 2003

Exhibit G-3  
Docket #0512-SP-12

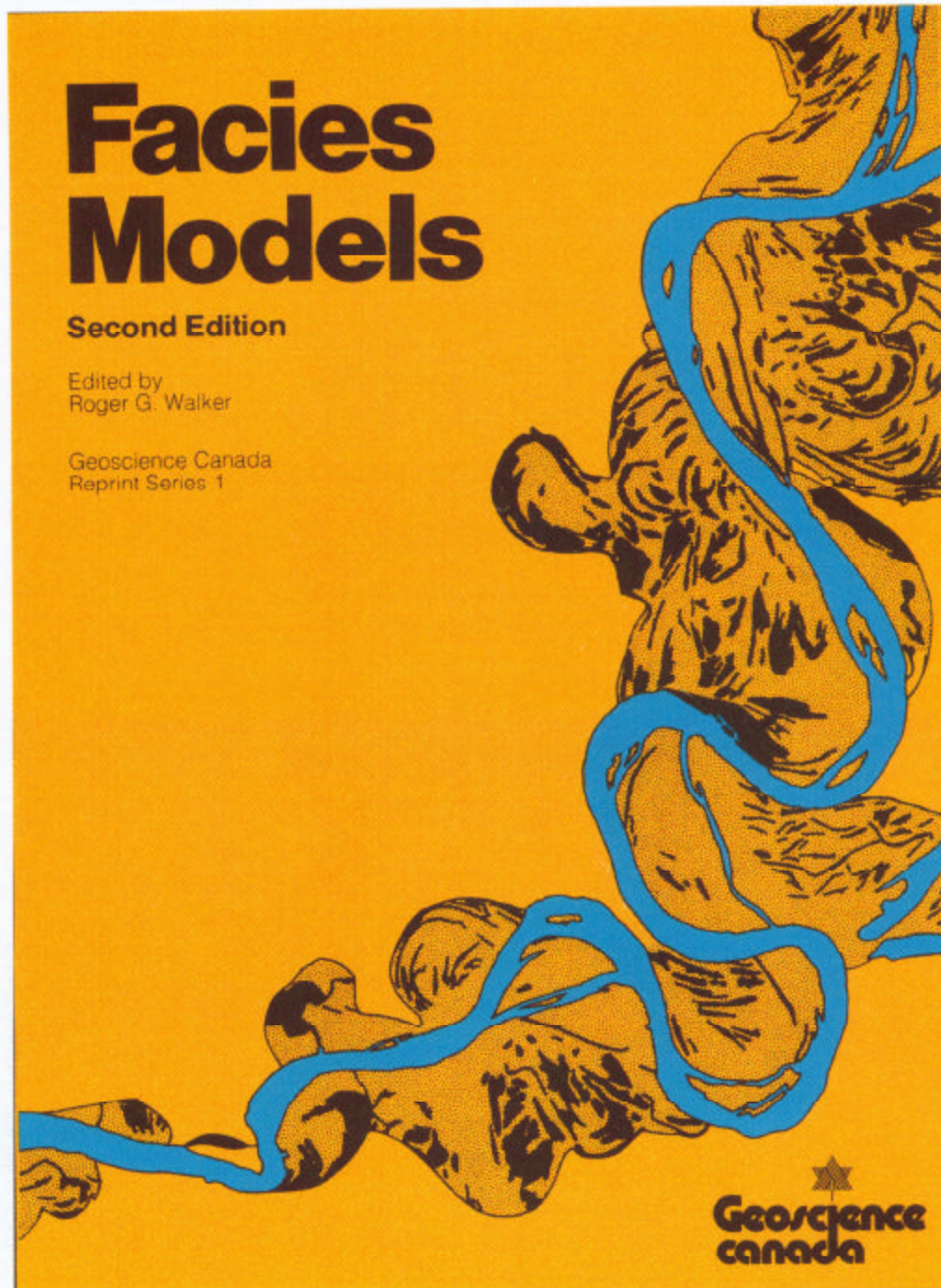
# Sand Body Illustration: Coal Canyon Outcrop



Upper illustration is a diagram of Lower Williams Fork sand bodies observed and measured in the Coal Canyon outcrop. This diagram illustrates size, and vertical and lateral relationships between sand bodies. Note that most sand bodies do not touch. Lower illustration shows types of sand bodies described in the Coal Canyon outcrop. Most of the sand bodies at Coal Canyon are point bar sandstones deposited by meandering streams. These sands are also the best potential reservoir rock. (Modified from Cumella and Otsby, 2003)



## Point Bar Deposits



# Facies Models

Second Edition

Edited by  
Roger G. Walker

Geoscience Canada  
Reprint Series 1

Cover illustration from Facies Models, Geoscience Canada Reprint Series 1. This diagram illustrates individual point bar sand bodies deposited by a meandering river system. Stippled areas are individual point bar sand bodies surrounded by oxbow lakes that isolate the individual sand bodies.

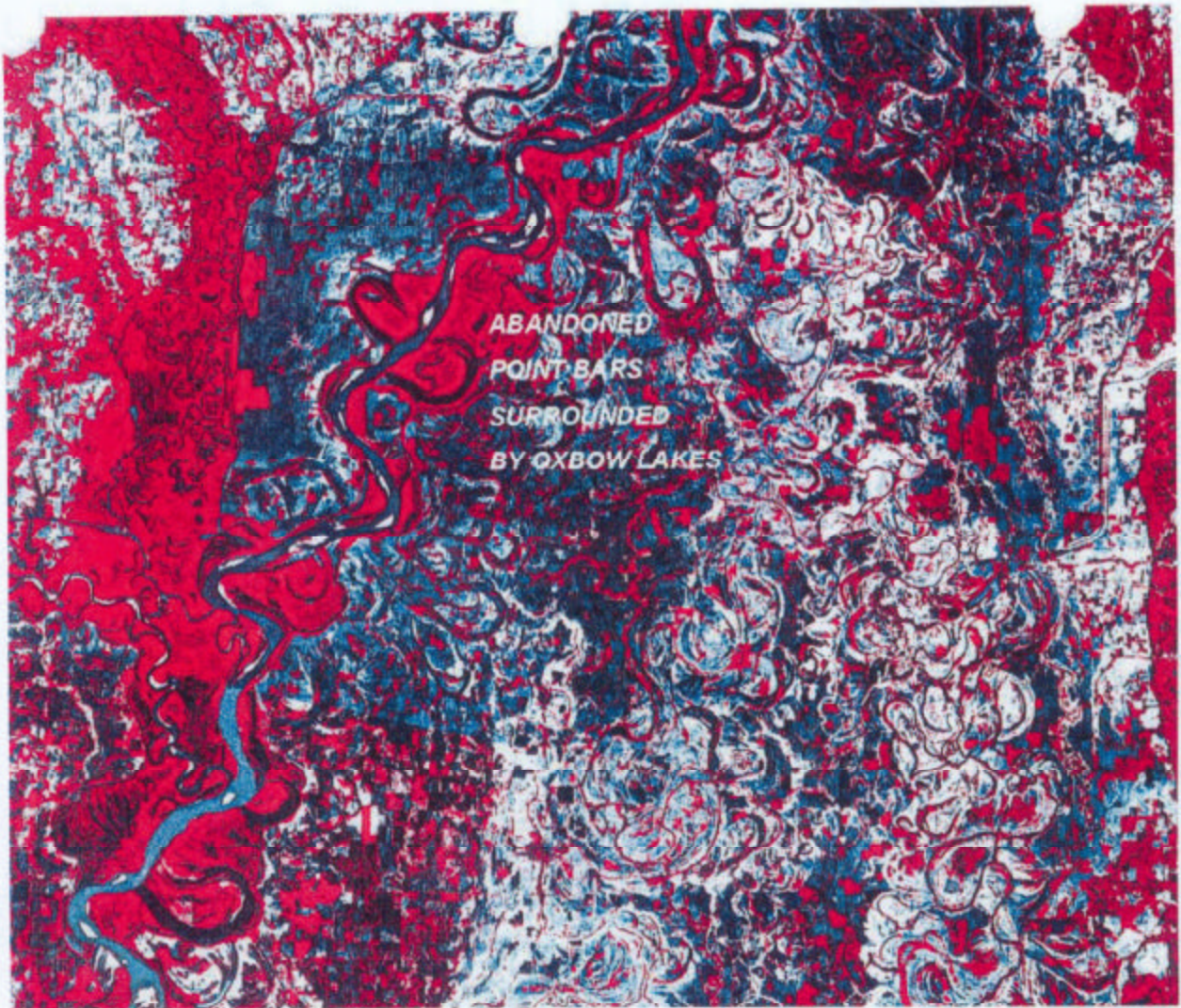
Walker, 1984

Exhibit G-5  
Docket #0512-SP-12



# Mississippi River Meanders

## Satellite Image



Satellite image of Mississippi River meander belt. Individual point bar sand bodies are surrounded by oxbow lakes formed when meanders are abandoned. Oxbow lakes fill with fine-grained muddy sediments that isolate the point bar sand bodies and prevent fluid communication between them. If this meander belt were preserved in the subsurface, the sand would appear to be nearly continuous on log cross-sections, but narrow impermeable barriers, usually not seen on logs would separate individual point bar sandstones.

Photo from Cumella and Otsby, 2003

Exhibit G-6  
Docket #0512-SP-12



# Sand Body Types and Statistics

	N	Minimum	Maximum	Mean	Median	Std. Dev.
<b>TOTAL POPULATION</b>						
Thickness (feet)	136	0.5	29.0	9.3	8.0	5.9
Apparent Width (feet)	136	40.1	2791.1	528.4	400.2	491.2
Width-Thickness Ratio	136	3.9	463.8	68.2	52.8	62.9

**TOTAL**  
**AVG WIDTH**  
**528 FEET**

<b>TYPE A SANDBODIES</b>						
Thickness (ft)	9	3.5	21.0	9.2	6.0	6.6
Apparent Width (ft)	9	46.4	290.5	98.5	81.0	74.0
Width-Thickness Ratio	9	3.9	14.5	11.8	12.6	3.3

**ANASTOMOSING**  
**OR AVULSION**

<b>TYPE B SANDBODIES</b>						
Thickness (ft)	30	4.1	18.0	8.8	7.7	3.5
Apparent Width (ft)	30	112.0	2316.3	505.1	400.2	450.3
Width-Thickness Ratio	30	16.4	227.1	61.3	41.3	50.0

**POINT BAR**

<b>TYPE C SANDBODIES</b>						
Thickness (ft)	55	4.5	29.0	13.8	13.2	5.1
Apparent Width (ft)	55	139.7	2791.1	814.8	674.3	545.3
Width-Thickness Ratio	55	9.1	158.6	61.4	53.3	35.9

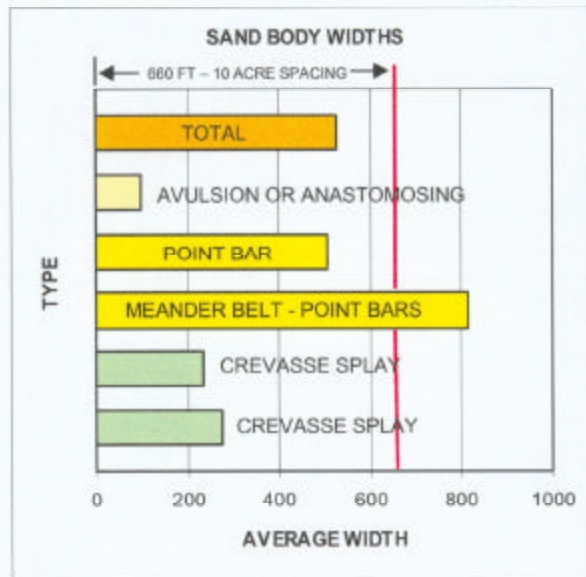
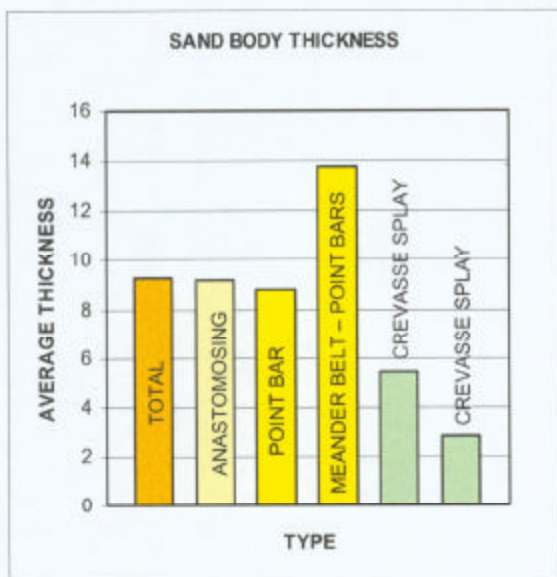
**MEANDER BELT**  
**POINT BARS**

<b>TYPE D SANDBODIES</b>						
Thickness (ft)	14	2.5	9.1	5.4	5.4	1.9
Apparent Width (ft)	14	72.9	510.4	234.8	165.4	152.5
Width-Thickness Ratio	14	13.9	122.1	44.7	37.3	26.3

**CREVASSE**  
**SPLAY**

<b>TYPE E SANDBODIES</b>						
Thickness (ft)	28	0.5	6.5	2.8	2.8	1.5
Apparent Width (ft)	28	40.1	843.3	275.7	247.4	201.9
Width-Thickness Ratio	28	21.7	463.8	119.0	92.8	100.0

**CREVASSE**  
**SPLAY**



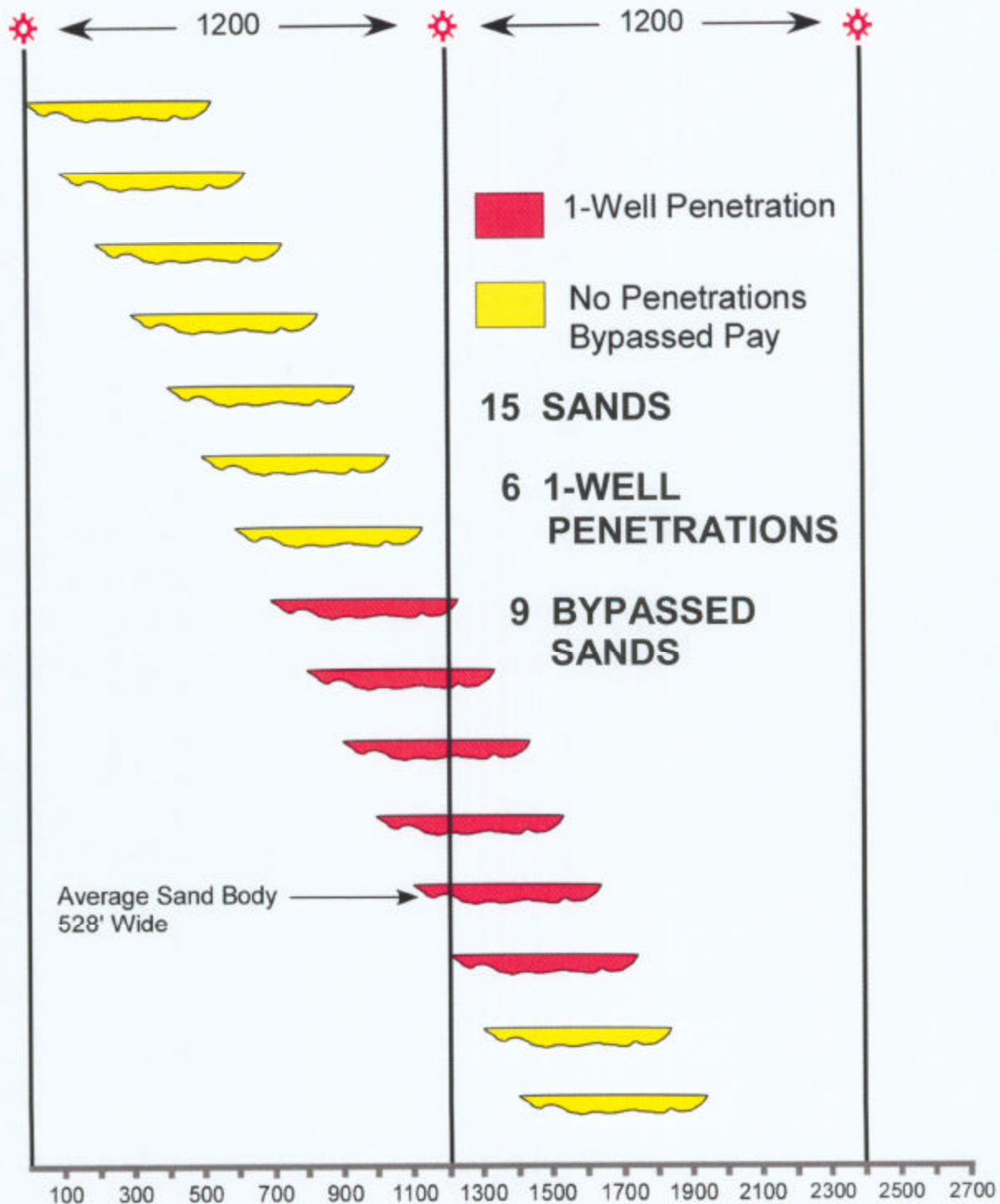
The best reservoir sand bodies are point bars and meander belts composed of point bars. Avulsion or anastomosing stream deposits are also good reservoirs, but they are too narrow to be penetrated often.

Table from Cole and Cumella, 2005

Exhibit G-7  
Docket #0512-SP-12

# AVERAGE SAND BODY 1200 FEET BETWEEN WELLS

Exhibit G-8  
Docket #0512-SP-12

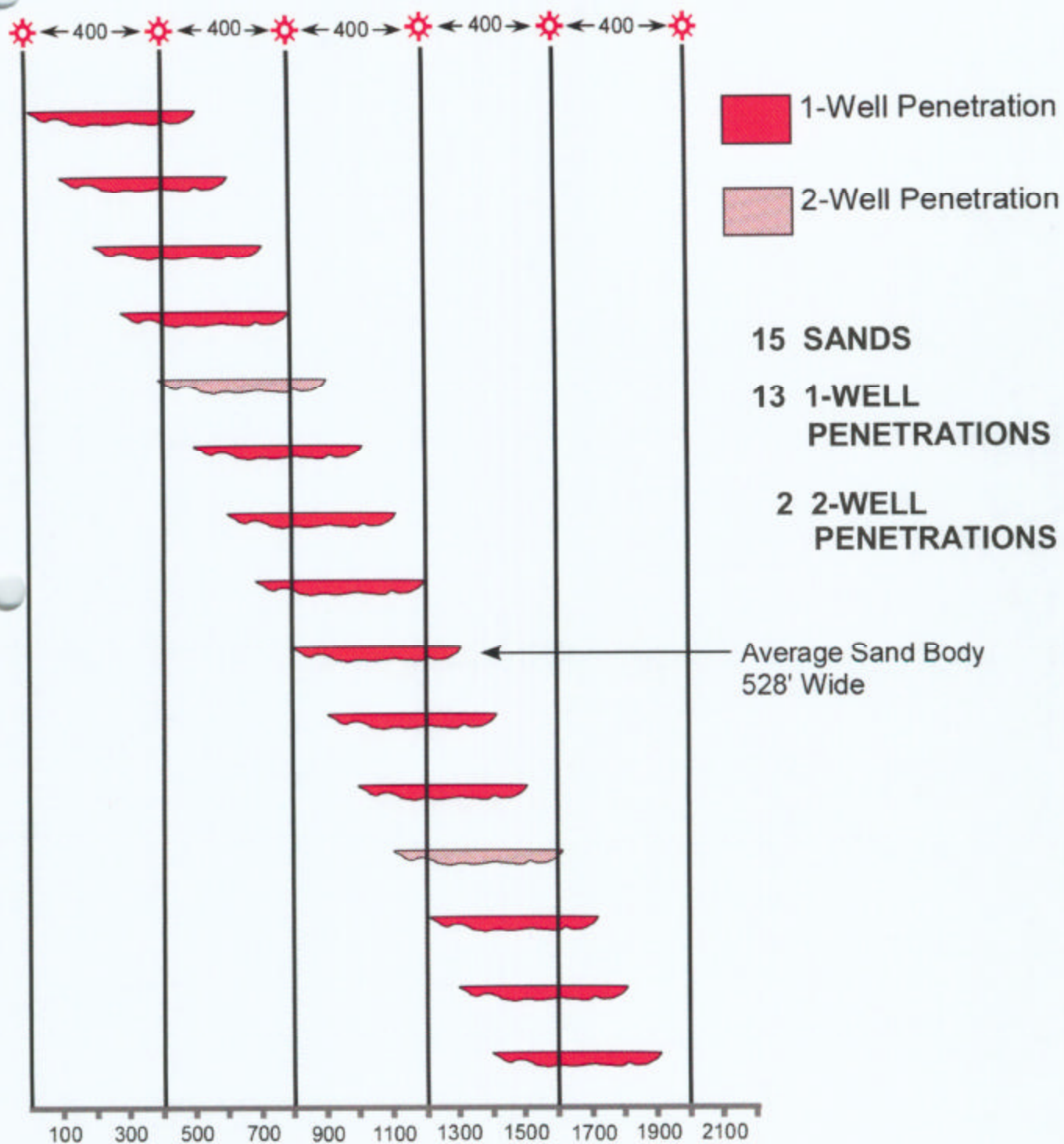


Average sand body widths are derived from Williams Fork outcrop studies in Coal Canyon published by Cole & Cumella, 2005 and by Cumella & Otsby, 2003.



## AVERAGE SAND BODY 400 FEET BETWEEN WELLS

Exhibit G-9  
Docket #0512-SP-12



Average sand body widths are derived from Williams Fork outcrop studies in Coal Canyon published by Cole & Cumella, 2005 and by Cumella & Otsby, 2003.



## Coal Canyon Williams Fork Outcrop on 10 Acre Density

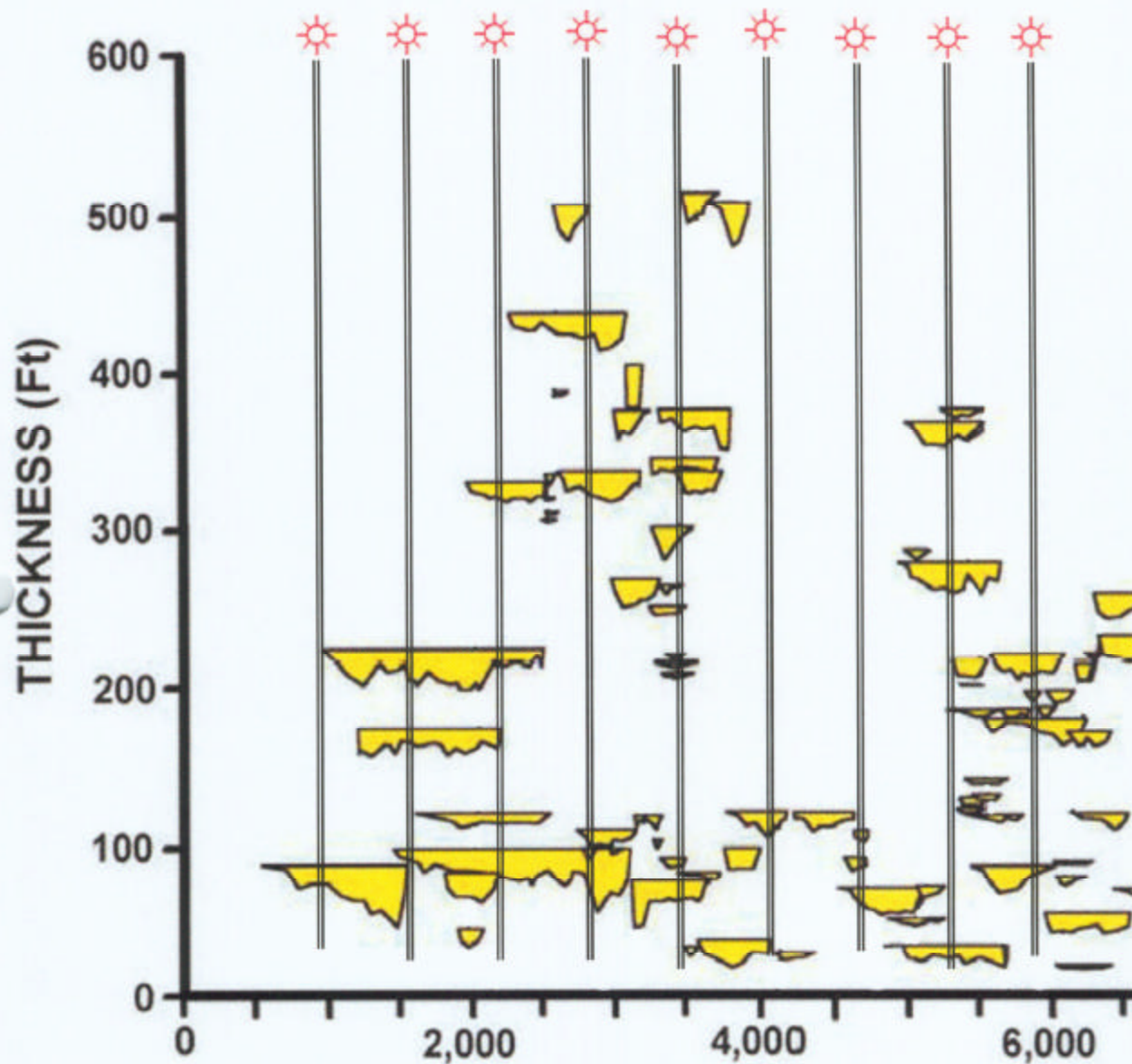


Diagram of western part of Coal Canyon Williams Fork outcrop displayed as if it were a subsurface cross-section drilled on 10 acre density. In this case most sands are penetrated by only one well. Some sands are bypassed and would not be produced. Three of the sands are penetrated by 2 wells.

Modified from Cumella and Otsby, 2003

Exhibit G-10  
Docket #0512-SP-12



## Gas in Place

Average Porosity	9.0%
Water Saturation	40.0%
Net Pay (ft)	404-934
Reservoir Pressure (psi)	1673-2927
Bg (SCF/RCF)	125-173

## **Gas In Place / Section 152 BCF**

<u>Area (acres)</u> <u>(BCF)</u>	<u>OGIP</u>
40	9.50
20	4.75
10	2.38



# Topography



Piceance Gas Resources



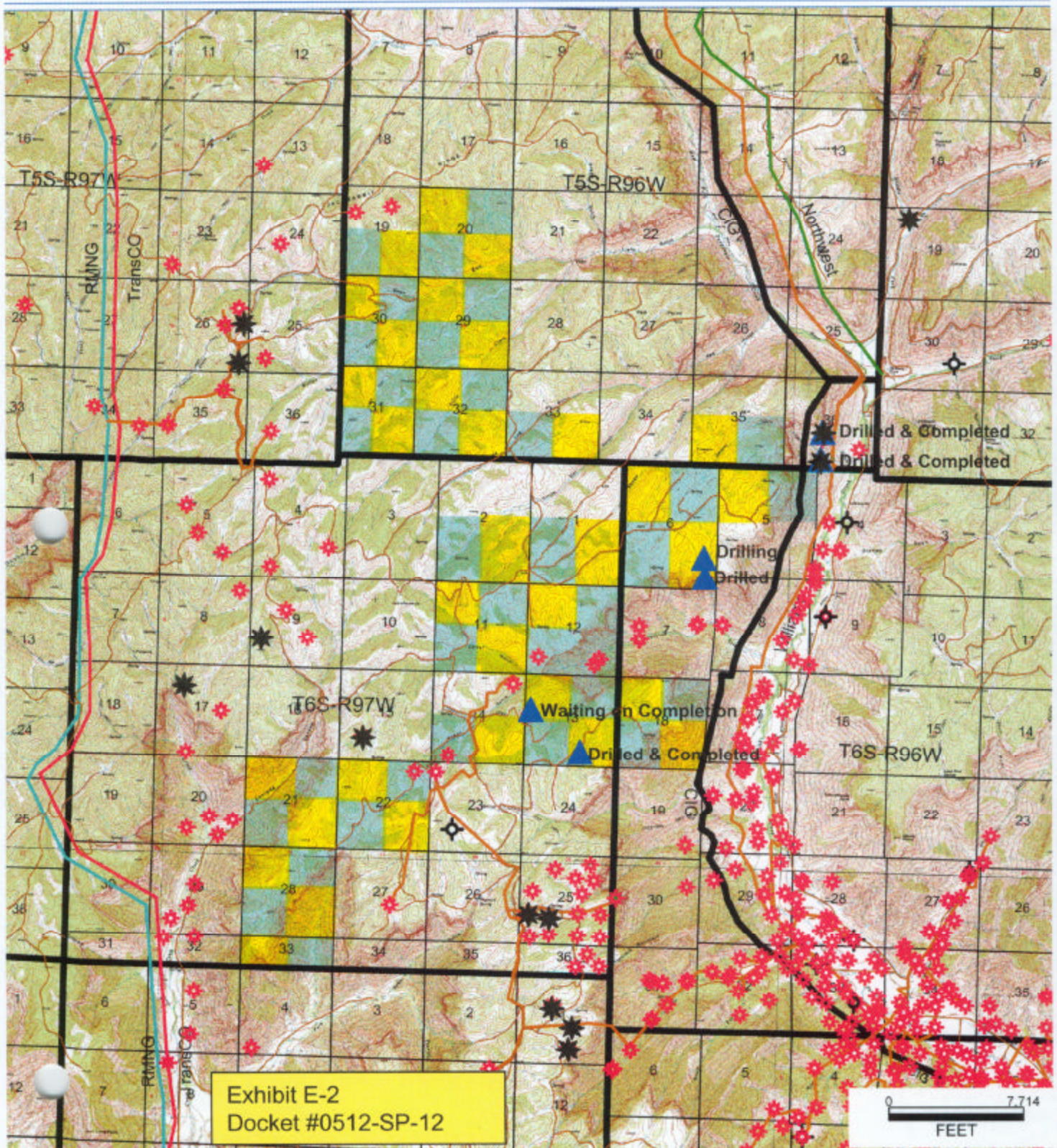
Petroleum Development Corporation



Type Well Data



Current Activity





# TYPE WELL

Forecast Parameters: (13 well average)

IP: 838 Mcfpd

Hyperbolic: B/1.5

Initial decline 40%

Outer decline 6% (exponential)

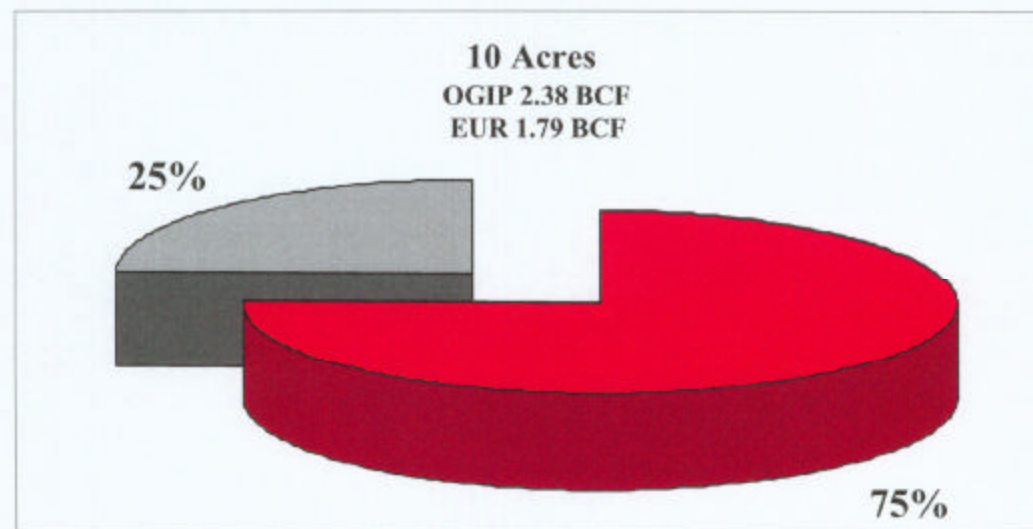
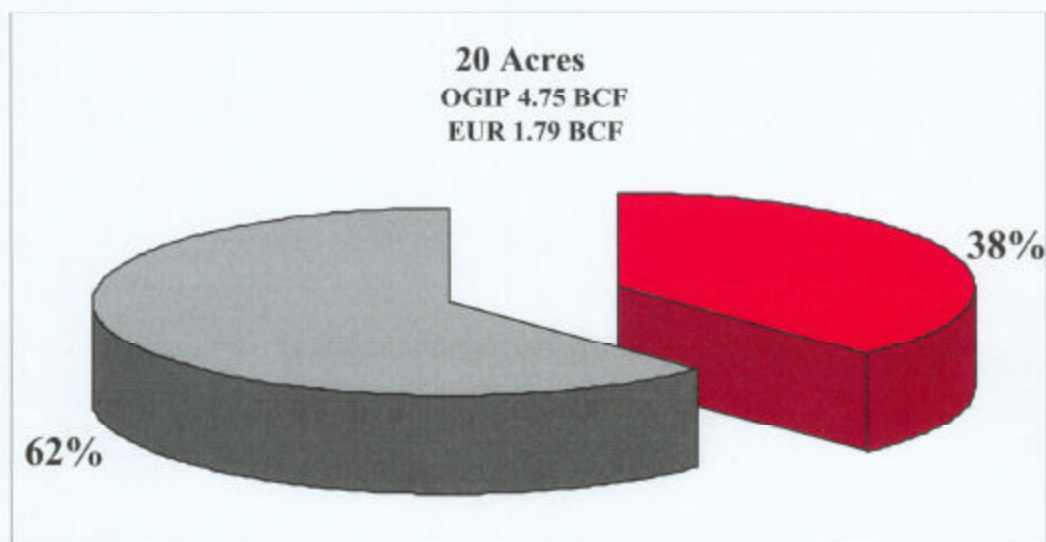
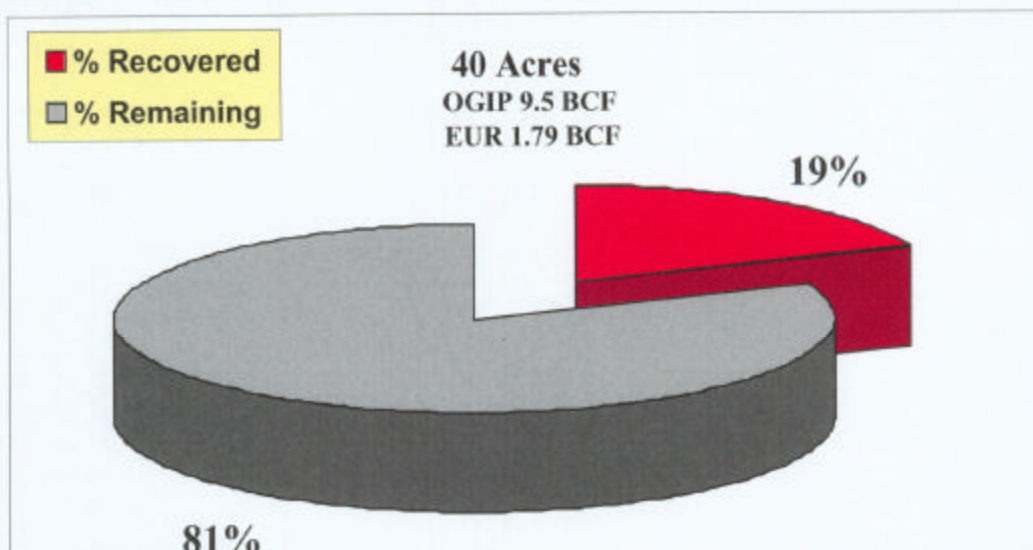
1.789 Bcf EUR



Exhibit E-3  
Docket # 0512-SP-12



# Gas Recovery Factor as a Function of Well Density





# TYPE WELL

## ECONOMIC SUMMARY

### Input:

- Well Cost – \$1,800,000 (Drill & Complete)
- Working Interest – 100%
- Net Interest – 78.75%
- IP – 838 Mcfpd
- Gross EUR – 1.789 Bcf
- Wellhead Gas Price: **\$9.19/MCF 2006**  
\$7.61/MCF 2007  
\$6.68/MCF 2008  
\$5.97/MCF 2009  
\$5.60/MCF 2010 and beyond
- Operating Costs – \$1,500 month + \$2.50/Bbl water disposal

### Results:

- ROR - 68%
- Pv@10% - \$2,591,372
- Payout (undiscounted) = 1.45 Yrs
- 36 Year Reserve Life

Exhibit E-5  
Docket # 0512-SP-12



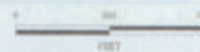
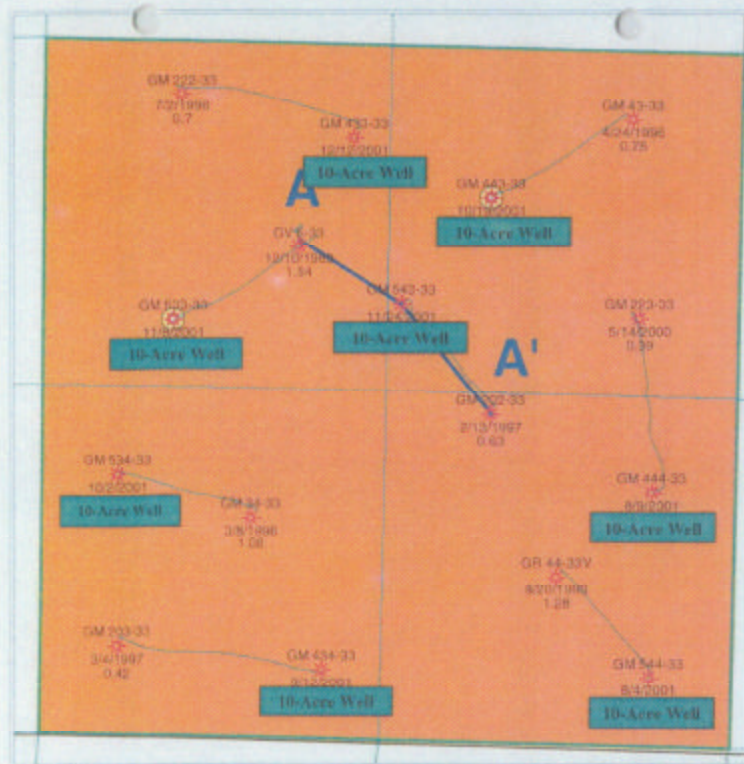
# Grand Valley 10-Acre Pilot SE/4 33-T6S-R96W

Well Name



Spud Date

Cum Prod (BCF)



POSTED WELL DATA

WELL NAME  
WELL SPUD DATE  
WELL CUM PROD (BCF)

A TYPICAL MAP



Exhibit E-6  
Docket # 0512-SP-12

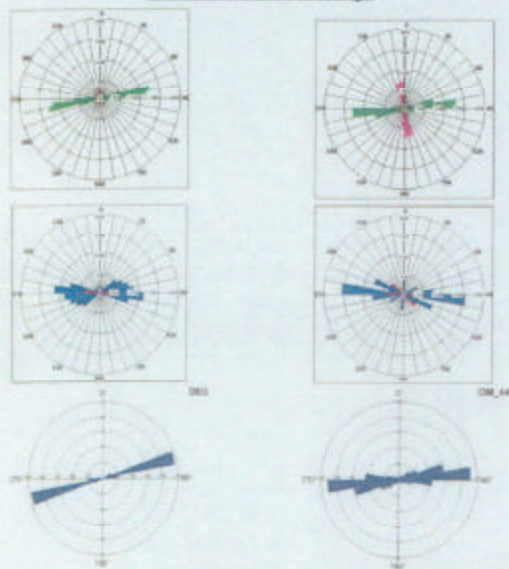


01122188

Exhibit: D-1  
Docket #: 0304-AW-03

## FMI and Microseismic Results

### Grand Valley

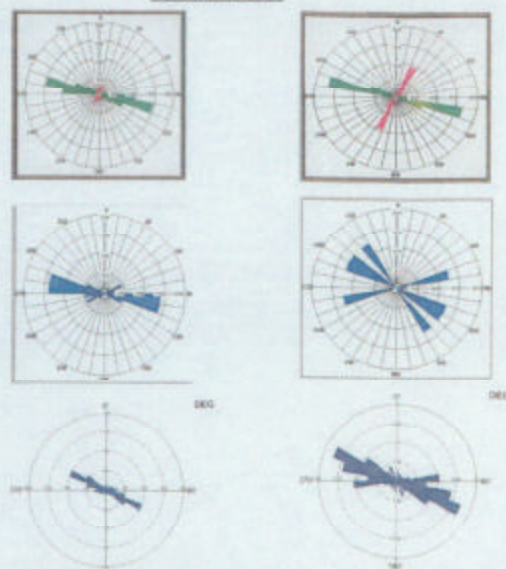


Drilling Induced  
Fractures

Natural Fractures

Hydraulic Fractures

### Rulison



FMI and Microseismic confirm both hydraulic and natural fracture orientations are approximately the same



Exhibit E-7  
Docket # 0512-SP-12



Exhibit: D-4  
Docket #: 0304-AW-03



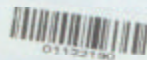
## 10-Acre Pilot Summary

	<u>Grand Valley</u>	<u>Rulison</u>	<u>Total</u>
Acres:	160	160	320
Existing Wells: (20-Acre Well Density)	8	8	16
Wells Drilled: (10-Acre Well Density)	8	8	16
Pressure Tests: (Individual Sands)	95	124	219
Microseismic Monitored Hydraulic Fracs:	6	8	14

Other Tests: 4 Production Logs, 7 RFT tests, 4 FMI logs



Exhibit E-8  
Docket # 0512-SP-12



01122190

Exhibit D-3  
Docket #: 0304-AW-03

## Grand Valley Pressure Testing Summary

Type of Test	# of Tests	No Depletion	Partially Depleted
20-acre Pilot Pressure Tests	7	6 86%	1 14%
Total 10-acre Pilot Pressure Tests	95	78 82%	17 18%
10-acre Pilot Pressure Tests (Without "Orientation Well")	75	66 88%	9 12%

## Rulison Pressure Testing Summary

Type of Test	# of Tests	No Depletion	Partially Depleted
20-acre Pilot Pressure Tests	7	7 100%	0 0%
Total 10-acre Pilot Pressure Tests	124	109 88%	15 12%
10-acre Pilot Pressure Tests (Without "Orientation Well")	98	92 94%	6 6%

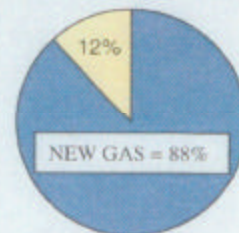


**No Depletion:** Virgin Reservoir Pressure or slightly less than virgin reservoir pressure (gas is not being effectively produced from offset wells)

**Partially Depleted:** Less than 75% of virgin reservoir pressure (gas from some sand bodies is being produced from offset wells)

## Exhibit E-9 Docket # 0512-SP-12

Grand Valley Reserves



Rulison Reserves

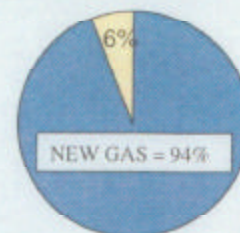


Exhibit: D-6  
Docket #: 0304-AW-03



## Grand Valley Average Monthly Production Comparison

\*10-Acre Average Does Not Include GM 443-33 "Orientation Well"

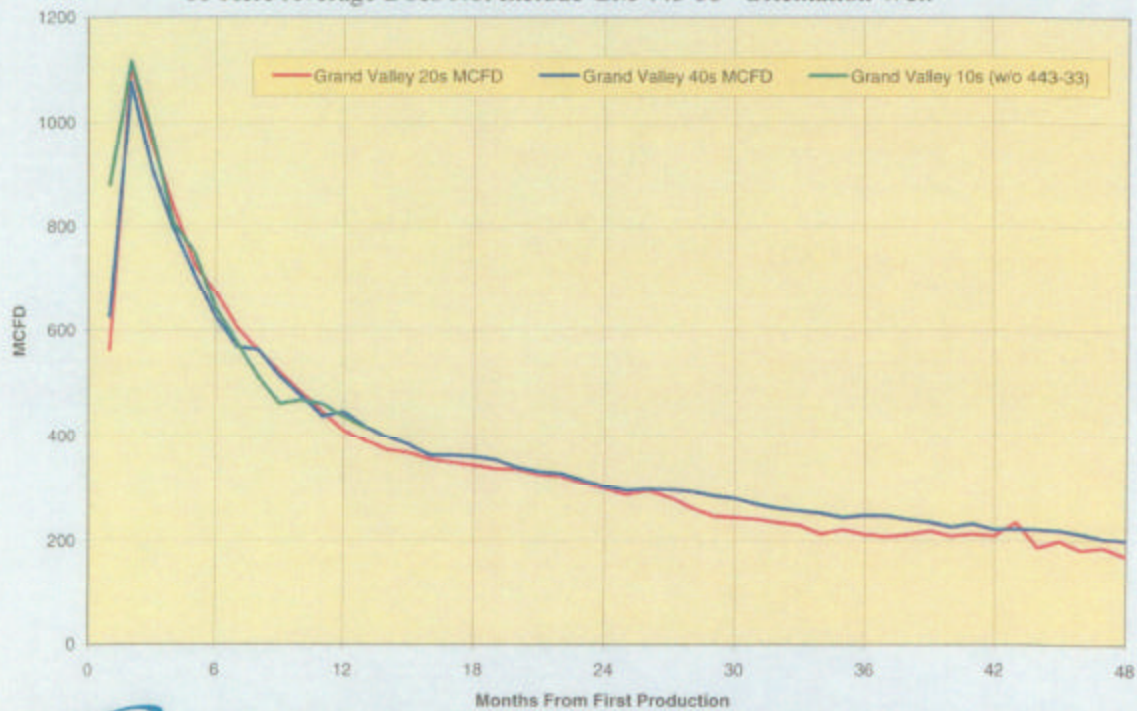


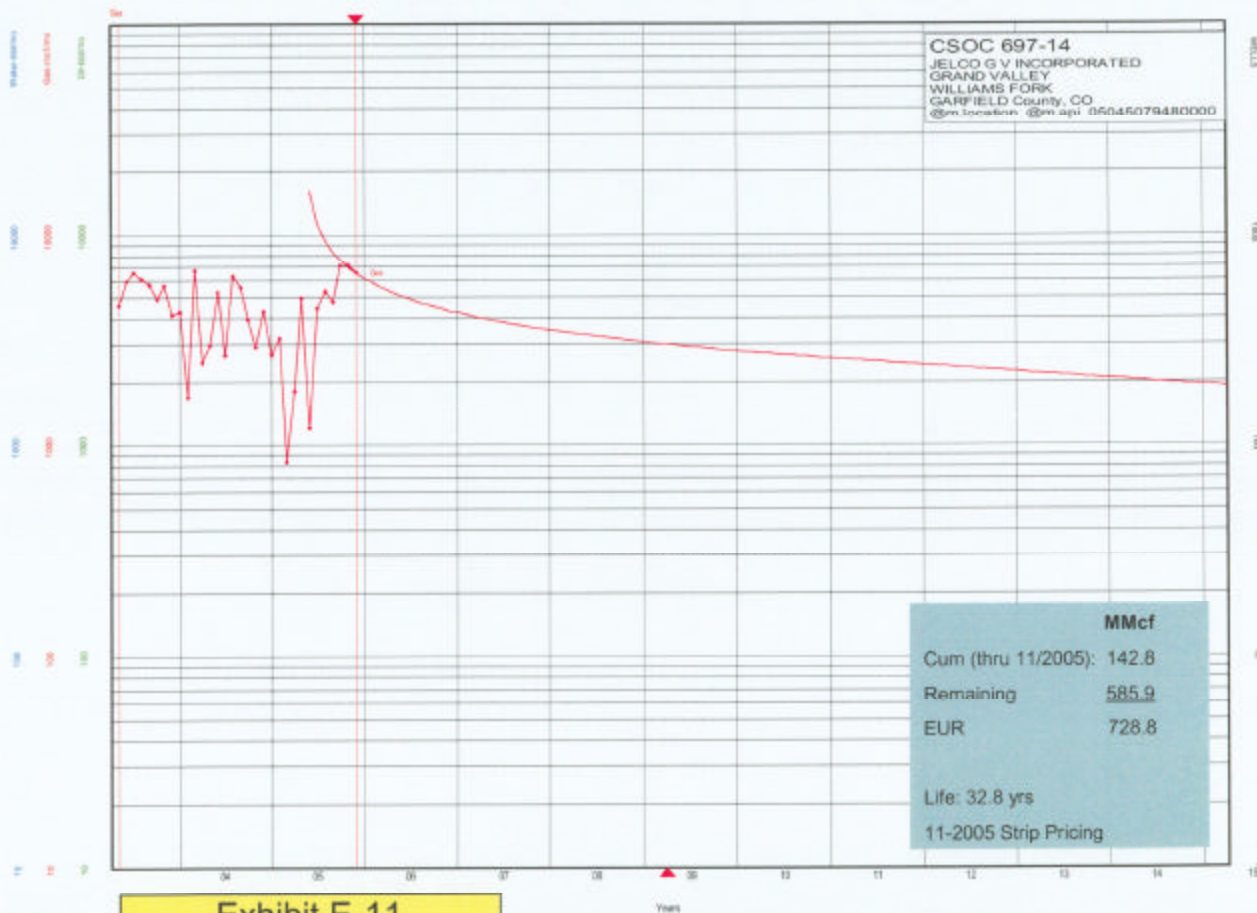
Exhibit E-10  
Docket # 0512-SP-12



01122196

Exhibit: D-9  
Docket #: 0304-AW-03







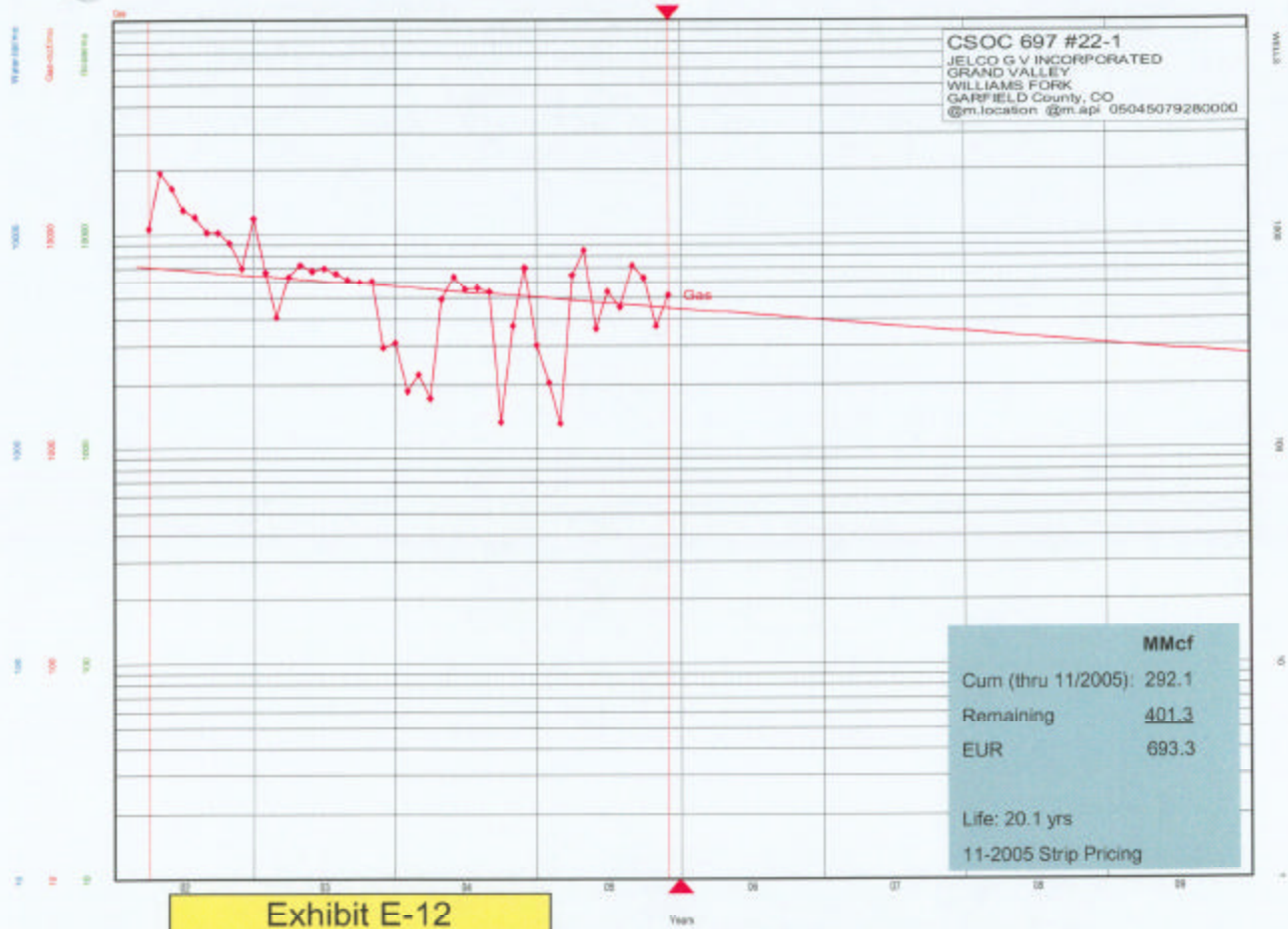
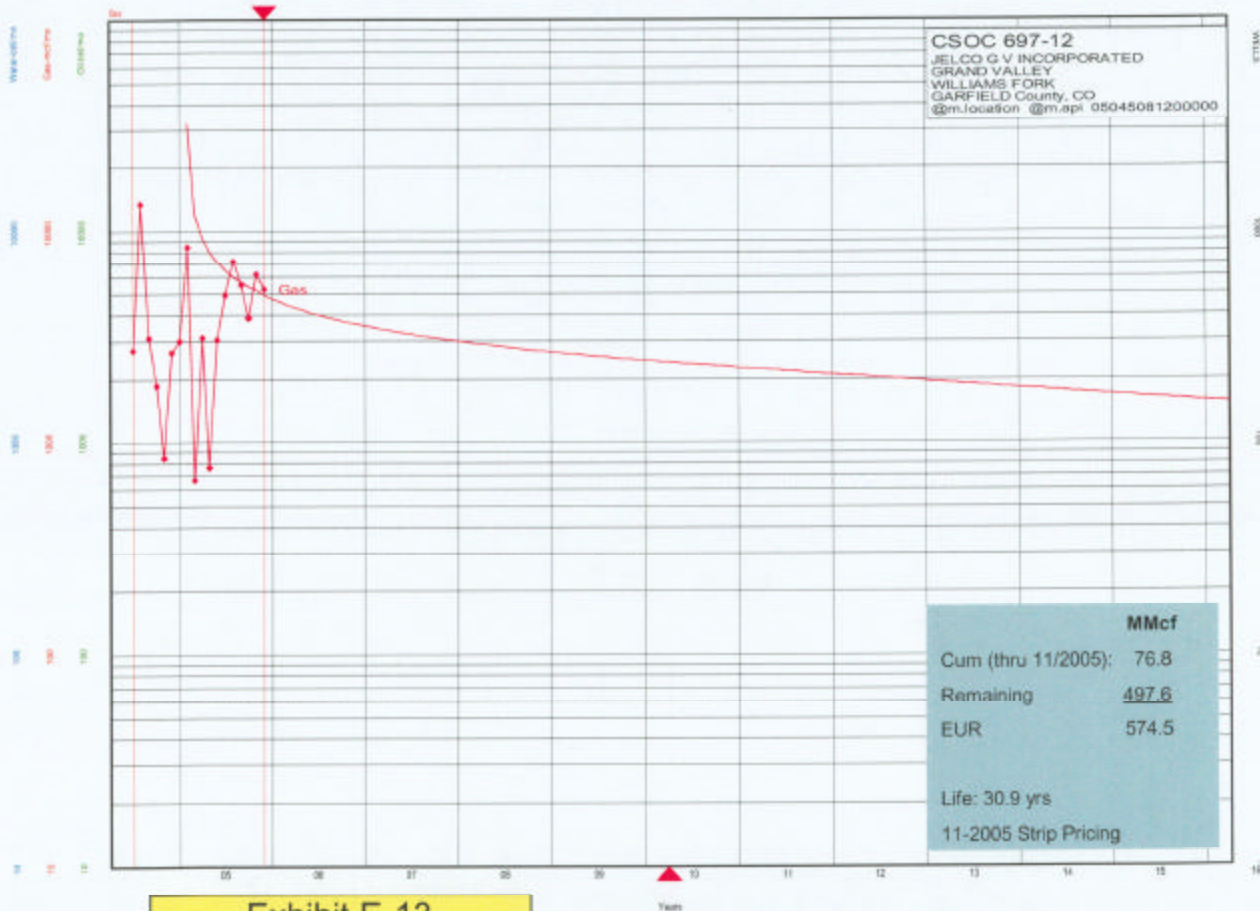


Exhibit E-12  
 Docket # 0512-SP-12





T6S-R97W

CSOC 697-12

400'

1200'

CSOC 697-14

CSOC 697-22

400'

1200'

Exhibit E-15  
Docket # 0512-SP-12